AN EXPERIMENTAL STUDY ON EFFECT OF STABILITY TRAINER EXERCISE ON BALANCE AND GAIT IN SUBJECTS WITH TYPE 2 DIABETIC PERIPHERAL NEUROPATHY

Dissertation submitted to

The Tamil Nadu Dr. M.G.R. Medical University

Chennai

In partial fulfillment of the requirements for the degree of

MASTER OF PHYSIOTHERAPY

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Reg. No. 271720004

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COLLEGE OF PHYSIOTHERAPY
SRI RAMAKRISHNA INSTITUTE OF PARAMEDICAL SCIENCES
COIMBATORE – 641044

CERTIFICATE

This is to certify that the dissertation work entitled **"AN EXPERIMENTAL STUDY ON EFFECT OF STABILITY TRAINER EXERCISE ON BALANCE AND GAIT IN SUBJECTS WITH TYPE 2 DIABETIC PERIPHERAL NEUROPATHY"** was carried out by the candidate bearing the **Register No. 271720004 (May 2019)** in College of Physiotherapy, SRIPMS, Coimbatore, affiliated to the Tamil Nadu Dr. M.G.R Medical University, Chennai towards partial fulfillment of the **Master of Physiotherapy (Neurology).**

Prof. B. SANKAR MANI, MPT (Sports)., MBA.,
Principal
College of Physiotherapy
SRIPMS
Coimbatore – 641044

Place: Coimbatore

Date:

CERTIFICATE

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Prof .R.Porkodi, MPT (Neurology).,
Guide
College of Physiotherapy
SRIPMS
Coimbatore – 641044

Place: Coimbatore

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

Place:

Date:

ACKNOWLEDGEMENT

With great privilege I express my deep sense of gratitude to the **God Almighty** for his blessings, love and care for me and who have always been my source of inner strength and courage throughout my life.

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ABBREVATIONS

- **DPN**–Diabetic peripheral neuropathy
- **DGI** –Dynamic gait index
- **BBS** –Berg Balance Scale

Abstract

ABSTRACT

Background:

In type2 diabetic patients,

Objective:

To determine the effect of stability trainer on dynamic balance and gait in patient with diabetic peripheral neuropathy.

Participants and methods:

The total of 30 subjects with type 2 diabetic peripheral neuropathy will be assigned in two groups with 15 subjects in each group.

G**roup A**: This group will receive Stability Trainer Exercise and Conventional Physiotherapy.

G**roup B**: This group will receive conventional physiotherapy alone.

Results:

There was significant difference between pre to post readings of DGI and BBS in both groups. In pre to follow up readings there was significant difference with DGI and BBS

Conclusion:

Our study shows that stability trainer exercise is more effective in improving gait and balance in type2 diabetes mellitus patient when compared with conventional exercise alone.

Keywords:

Type2Diabetes mellitus, Stability training, Gait and Balance.

CONTENTS

Introduction

1. INTRODUCTION

Diabetic peripheral neuropathy (DPN) is one of the common complications and quality of life damaging factor in diabetic patients.[1]Peripheral neuropathy leads to sensory and motor deficits, which often result in mobility related dysfunction, alternations in gait characteristics. [2] Diabetic peripheral neuropathy (DPN), a micro vascular complication of diabetes, is associated with considerable mortality, morbidity and diminished quality of life. Characterized by pain, paresthesia and sensory loss, it affects up to 50% of patients with diabetes with new cases occurring at an annual incidence of about 2% in India. In absolute numbers, against the estimated global prevalence of 220 million cases of diabetes by 2010, DPN is likely to affect as many as 110 million persons worldwide and at tremendous cost.[3]Type 2 diabetes mellitus constitutes a major challenge in low-middle income countries. Diabetic peripheral neuropathy is one of the most important complications of diabetes mellitus and can have a huge impact on patients, families, and society.[4]

Diabetic patients with peripheral neuropathy have lower gait velocity, decreased cadence, shorter stride length, increased stance time and higher step to step variability compared with healthy controls.[3]

Diabetic peripheral neuropathy individuals show postural instability with a larger center of pressure displacement, higher sway area, greater instability while standing with eye closed. In addition to these gait and balance impairment, diabetic patients are known to suffer from increased of injurious falls.[5]

Effect of a specific physical training programe not only on the activity level and quality of life of diabetic patients, but also on their habitual and maximal walking speed.[6]

Stability trainers are oval shaped color coded pads, available in three densities as follow, (1) Green with smaller surface area and firm density, (2) Blue with larger surface area and soft density and 3. Black with air filled inflatable extra soft pad. Levels of challenge were determined by an increasing order of instability. A fixed set of exercises were designed to perform on stability trainer.[7]

Extrinsic feedback from therapist about their posture and intrinsic feedback from stability trainer helps them in improving balance. Somatosensory training using stability trainer can also augment increased proprioceptive firing from the cutaneous receptors from the feet and also from mechanoreceptors of the muscles during co-contraction produced by the swaying movements, while standing on stability trainer. Stability trainer provides an unsteady surface that challenges the body to maintain balance. During the exercise intervention with stability trainer, sensory inputs could be manipulated by altering the support surfaces and environments.[3]

1.1 NEED OF THE STUDY

Diabetic peripheral neuropathy is a common disorder affecting quality of life with impairment in sensory and motor function, where the strength is absolutely weak with decreased stability and mobility of the lower limb. There are only less number of studies have focused on gait and balance in subjects with type 2 diabetic peripheral neuropathy. Hence this study is under taken with an attempt to analyze effect of stability trainer on balance and gait in subjects with type 2 diabetic peripheral neuropathy.

1.2 OBJECTIVES

To find out the effectiveness of stability trainer exercises with conventional physiotherapy on balance and gait in patients with type 2 diabetic peripheral neuropathy.

To find out the effectiveness of conventional physiotherapy on balance and gait in patients with type 2 diabetic peripheral neuropathy.

To find out the difference between effectiveness of stability trainer exercises with conventional physiotherapy and conventional physiotherapy alone on balance and gait in patients with type 2 diabetic peripheral neuropathy.

1.3 HYPOTHESIS

Null hypothesis:

There will be no significant difference between effectiveness of stability trainer exercises with conventional physiotherapy and conventional physiotherapy alone on balance and gait in patients with type 2 diabetic peripheral neuropathy.

Alternative hypothesis:

There will be significant difference between effectiveness of stability trainer exercises with conventional physiotherapy and conventional physiotherapy alone on balance and gait in patients with type 2 diabetic peripheral neuropathy.

Review of Literature

2. REVIEW OF LITERATURE

1) **Irshad Ahmed, et al (2017)** suggested that balance exercises are feasible and safe, and have the potential to improve balance and gait function in people with diabetic peripheral neuropathy.

2) **Chan, et al (2017)** have confirmed that the Time up and go test is a reliable, valid, and easy-to-administer clinical tool for assessing advanced functional mobility after a stroke.

3) **Xi Pan, et al (2014)** concluded that proprioception training, vestibular training, lower limb strength training and mixed sports training could enhance balance and reduce its risk of falling in elderly people with diabetic peripheral neuropathy.

4) **Patricia M, et al (2012)** have found that improvements in neuropathic and cutaneous nerve fiber branching following supervised exercise in people with diabetic peripheral neuropathy.

5) **Mohammad Akbari, et al (2012)** have found that diabetic patients who experience peripheral neuropathy and consequent balance problems can achieve better balance and stability through progressive balance training with emphasis on the anterior-posterior neuromuscular elements of stability.

6) **MSAjimsha, et al (2011)** concluded that the balance training on stability trainer along with conventional was more effective than a control intervention consisting of conventional physiotherapy alone, in improving functional balance in Type 2 diabetic patients with moderate diabetic sensory neuropathy.

7) **Song CH, et al (2011)** have concluded that balance exercise program improved balance and trunk proprioception.

8) **l. Allet, et al (2009)** concluded that strengthening training and balance training can improve gait speed, balance, muscle strength and joint mobility in diabetic patients.

9) **Jonsdottir J, et al (2007)** have concluded that the dynamic gait index showed high reliability and showed evidence of concurrent validity with other balance and mobility scales. It is a useful clinical tool for evaluating dynamic balance in ambulatory people with chronic stroke.

10) **Boulton, A. J. M., Malik (2004)** concluded that diabetic peripheralneuropathy is one of the most common complications of diabetes.

11) **Hodasalsabili, et al (2011)** concluded that dynamic stability training improves standing balance control in neuropathic patients with type 2 diabetes.

12) **Lara All et, et al (2009)** suggested that specific gait and balance training programe based on a circuit approach including gait and balance exercises combined with functional oriented strengthening can improve gait speed, balance and increase both muscle strength and joint mobility of diabetic patient.

13) **Hylton B. Menz, et al (2004)** concluded that when walking on a irregular surface, people with diabetic neuropathy exhibit clear differences in stability related acceleration pattern of the head and pelvis despite adopting a conservative gait patter.

14) **Dingwell J, et al (2003)** concluded that slower speed in patients with diabetic neuropathy lead to improved local dynamic stability of continuous over ground walking.

15) **Bina Eftekhar- Sadat et al (2015)** concluded that balance training with biodex balance system improve timed up and go and berg balance scale and biodex balance system indices, especially the risk of falling and could be used as a useful device in treating diabetic neuropathy patient with postural instability and risk of falling.

Methodology

3. METHODOLOGY OF THE STUDY

3.1 MATERIALS USED

- Assessment chart
- Bosu ball
- Plinth

3.2 METHODS OF STUDY

3.2.1 STUDY DESIGN

The study design is pre and post test experimental study design.

3.2.2 STUDY SETTING

The study is conducted at the Department of Physiotherapy, Sri Ramakrishna Hospital, under the supervision of the guide, College of physiotherapy, SRIPMS, Coimbatore.

3.2.3 STUDY DURATION

The study duration is One year.

3.2.4 SAMPLE DESIGN

Purposive sampling.

3.2.5 SAMPLE SIZE

The total of 30 subjects with type 2 diabetic peripheral neuropathy will be assigned in two groups with 15 subjects in each group.

Experimental group: Both Stability Trainer Exercise and Conventional Physiotherapy is given to GROUP A.

Control group: conventional physiotherapy alone is given to

GROUP B.

3.2.6 CRITERIA FOR SAMPLE SELECTION

INCLUSION CRITERIA:

- Age 50-60 years
- Both gender (male and female)
- Able to make unipedal stance for 20 seconds
- Ability to complete 2 min walk
- Strength of both lower limb muscles at least MRC grade 3

EXCLUSION CRITERIA

- Patients with vestibular dysfunction
- Central nervous system dysfunction
- Musculoskeletal deformity
- Cardiovascular problems
- Planter ulcer
- Visual defects

3.2.7 OUTCOME MEASURES

Dynamic gait index

Berg-balance scale

3.2.8 VARIABLES

Dependent variables

Gait

Balance

Independent variables

Stability trainer exercises

Conventional physiotherapy

3.3 STATISTICS

Descriptive and Inferential statistics.

METHODOLOGY

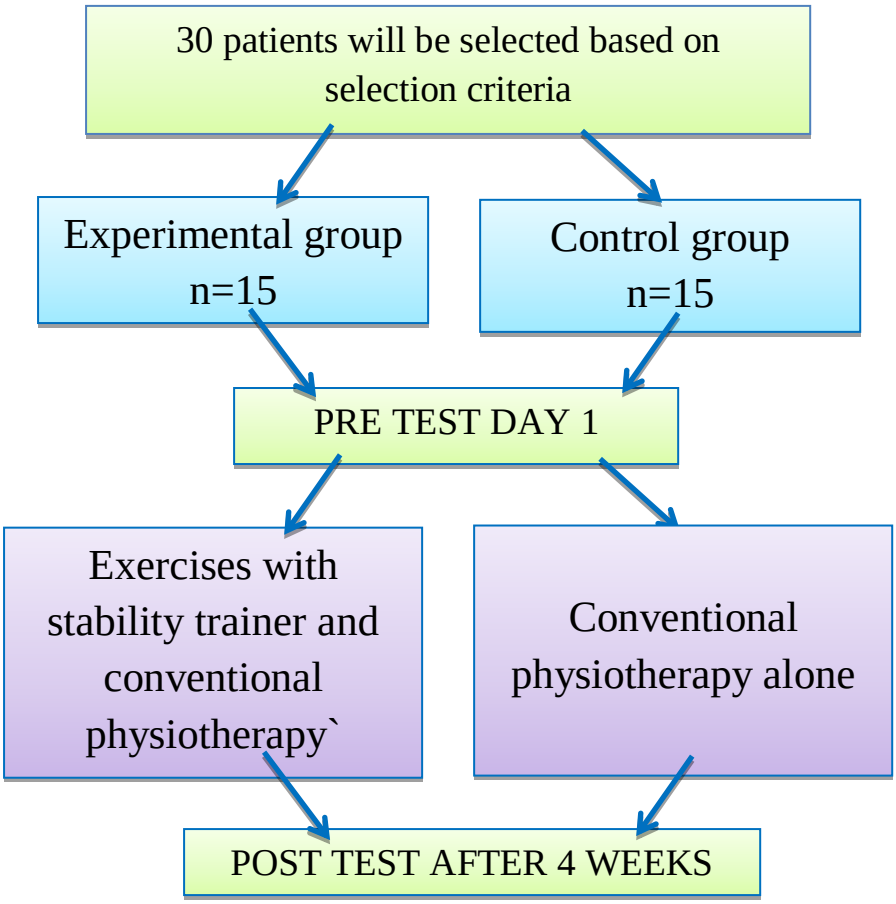


Fig 1: Flow chart of study method

3.4. PROCEDURE

Procedure is explained to the all patients consent form is obtained from the patient. Each patient is treated for 4 days a week for 4 weeks each therapy session lasting for about 45 minutes.

EXPERIMENTAL GROUP (Stability trainer and conventional physiotherapy)

Stability trainer

a) Bipedal heel raise for 20 sec (5 sets)
b) Bipedal toe raise for 20 sec (5 sets)
c) Balancing in unilateral stance for 30 sec (5 sets)
d) Balancing in bilateral stance for 60 sec (3 sets)
e) Half squatting for 30 sec (5 sets)

Balancing in unilateral stance

Fig2: Balancing in unilateral stance

Fig3: Half Squatting

CONTROL GROUP (Conventional physiotherapy alone)

1. Relaxed deep breathing exercises (3min)
2. ROM exercises for bilateral ankle joints
3. Functional exercises:

   a) Sit to stand (15 times)

   b) Functional reach-sideways and forward (15 times)

   c) Standing weight shift (15 times)

   d) Bipedal heel raise for 20 sec (15 times)

   e) Uni pedal stance for 30 sec (5 times)

   f) Uni pedal standing with knee bending for 10 sec (5 times)

4. Strength training:

   a) Static quadriceps exercise 20 sec (3 times)

   b) SLR 20 sec (3 times)

   c) Terminal knee extension (15 times)

   d) Squatting (15 times)

5. Gait training

   a) Tandem walk (5 min)

   b) Spot marching (5min)

Data Analysis & Result

4. DATA ANALYSIS AND RESULTS

Data collected from participants of the same group (intra group) were analyzed using paired‘t’ test and the difference between the two groups (inter group) were analyzed using independent‘t’ test. Differences were considered at significant level of 0.05%.

Independent ‘t’ test:

The “t” value was calculated using the formula,

$$\mathbf{t} = \frac{\bar{x}_1 - \bar{x}_2}{s}\sqrt{\frac{n_1 n_1}{n_1 + n_1}}$$

$$\mathbf{S} = \sqrt{\frac{\sum(x_1 - x_1^1)^2 + \sum(x_2 - x_2^1)^2}{n_1 + n_2 - 2}}$$

$$\boldsymbol{\delta} = \sqrt{\frac{\Sigma d^2 - n(\sum d)^2}{n-1}}$$

Paired ‘t’ test:

The “t” value was calculated using the formula,

$$\text{‘t’} = \frac{(\sum D)/N}{\sqrt{\frac{\sum D^2 - \frac{\sum D^2}{N}}{(N-1)(N)}}}$$

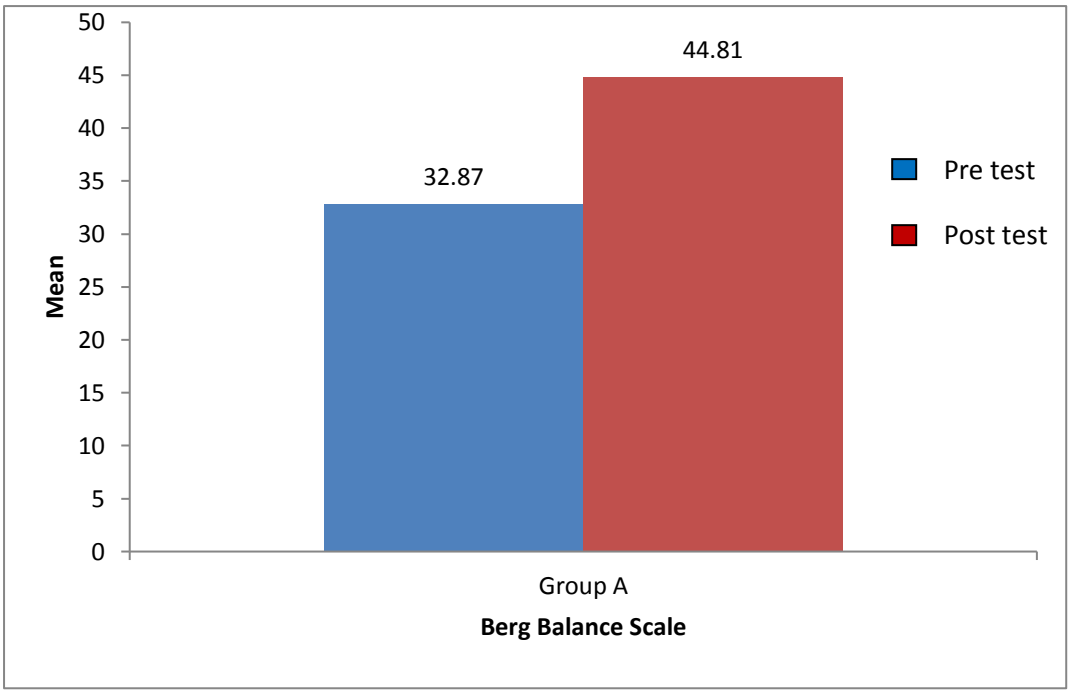
4.1 BERG BALANCE SCALE

GROUP A

TABLE-4.1.1

S.no	Pre test	Post test (x_1)	$X_1-X_1^1$	$(X_1-X_1^1)^2$
1	30	40	-4.47	19.98
2	34	41	-3.47	12.04
3	33	42	-2.47	6.10
4	32	43	-1.47	2.16
5	30	40	-4.47	19.98
6	31	43	-1.47	2.16
7	35	49	4.53	20.52
8	37	50	5.53	30.58
9	30	40	-4.47	19.98
10	31	44	-0.47	0.22
11	35	45	0.53	0.28
12	36	50	5.53	30.58
13	32	45	0.53	0.28
14	33	47	2.53	6.40
15	34	48	3.53	12.46

Graph I: Berg balance scale scoring for Group A



Berg Balance scale scoring for Group A

Outcome measure	Test	Mean	Standard deviation (SD)	Calculated 't' value	P value
Berg Balance scale	Pretest	32.87	2.26	20.46	<0.0001
	Posttest	44.81	3.76		

There was a significant difference in the outcome measure of Berg Balance Scale in the Experimental group at the level 0.05% at 14 degrees of freedom.

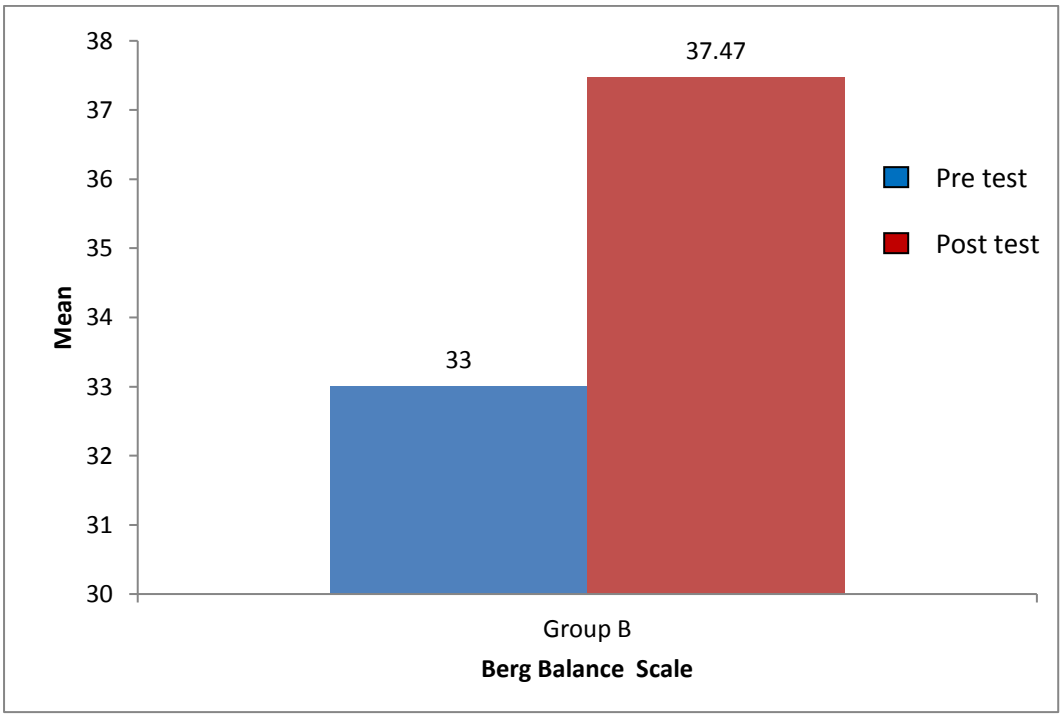
BERG BALANCE SCALE

GROUP B

Table - 4.1.2

S. no	Pre test	Post test (X_2)	$X_2-X_2^1$	$(X_2-X_2^1)^2$
1	30	35	-2.47	6.10
2	30	36	-1.47	2.16
3	30	34	-3.47	12.04
4	31	35	-2.47	6.10
5	31	36	-1.47	2.16
6	33	38	0.53	0.28
7	33	37	-0.47	0.22
8	34	39	1.53	2.34
9	36	39	1.53	2.34
10	33	38	0.53	0.28
11	35	39	1.53	2.34
12	37	38	0.53	0.28
13	35	40	2.53	6.40
14	34	39	1.53	2.34
15	33	39	1.53	2.34

Graph II: Berg balance scale scoring for Group B



Berg Balance scale scoring for Group B

Outcome measure	Test	Mean	Standard deviation (SD)	Calculated 't' value	P value
Berg Balance scale	**Pretest**	33.0	2.24	13.884	<0.0001
	Posttest	37.47	1.85		

There was a significant difference in the Berg balance scale in group B at the level 0.05% at 14 degrees of freedom.

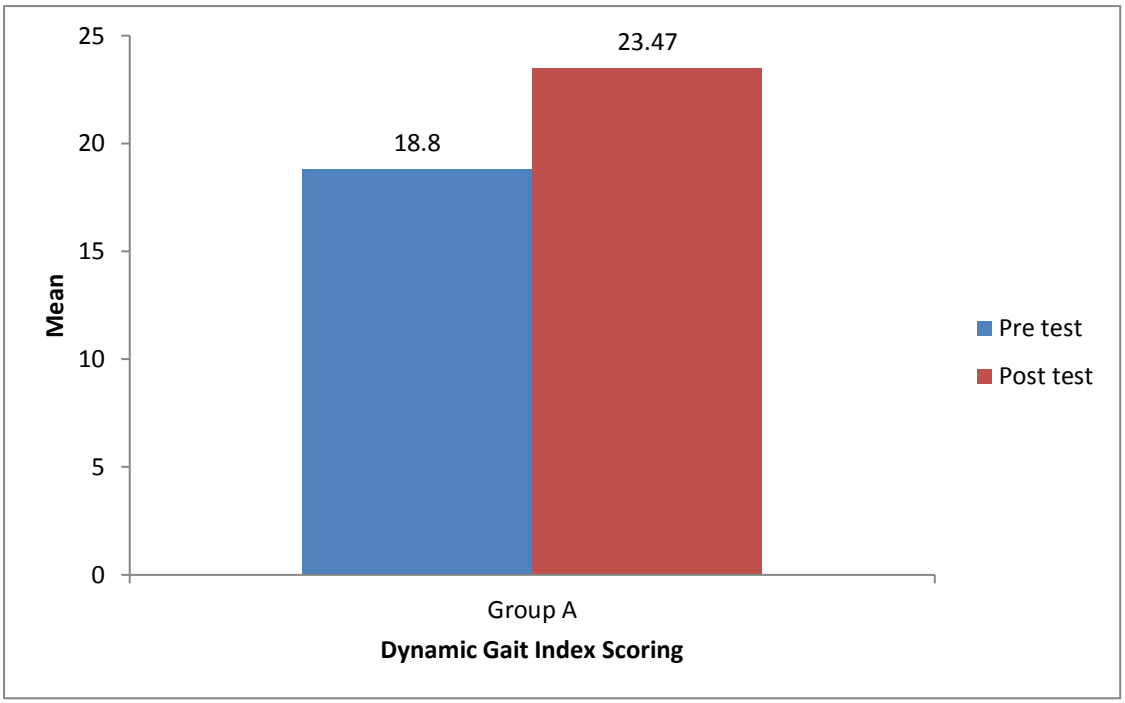
4.2 DYNAMIC GAIT INDEX

GROUP A

Table 4.2.1

S.no	Pre test	Post test (x_1)	$X_1-X_1^1$	$(X_1-X_1^1)^2$
1	18	23	-0.47	0.22
2	19	24	0.53	0.28
3	18	24	0.53	0.28
4	19	24	0.53	0.28
5	18	23	-0.47	0.22
6	20	24	0.53	0.28
7	18	24	0.53	0.28
8	20	23	-0.47	0.22
9	19	24	0.53	0.28
10	20	23	-0.47	0.22
11	19	23	-0.47	0.22
12	18	23	-0.47	0.22
13	19	23	-0.47	0.22
14	18	23	-0.47	0.22
15	19	24	0.53	0.28

Graph III: Dynamic gait index scoring for Group A



Dynamic gait index scoring for Group A

Outcome measure	Test	Mean	Standard deviation (SD)	Calculated 't' value	P value
Dynamic Gait Index	Pretest	18.80	0.77	20.088	<0.0001
	Posttest	23.47	0.52		

There was a significant difference in the Dynamic Gait Index of experimental training group at the level 0.05% at 14 degrees of freedom.

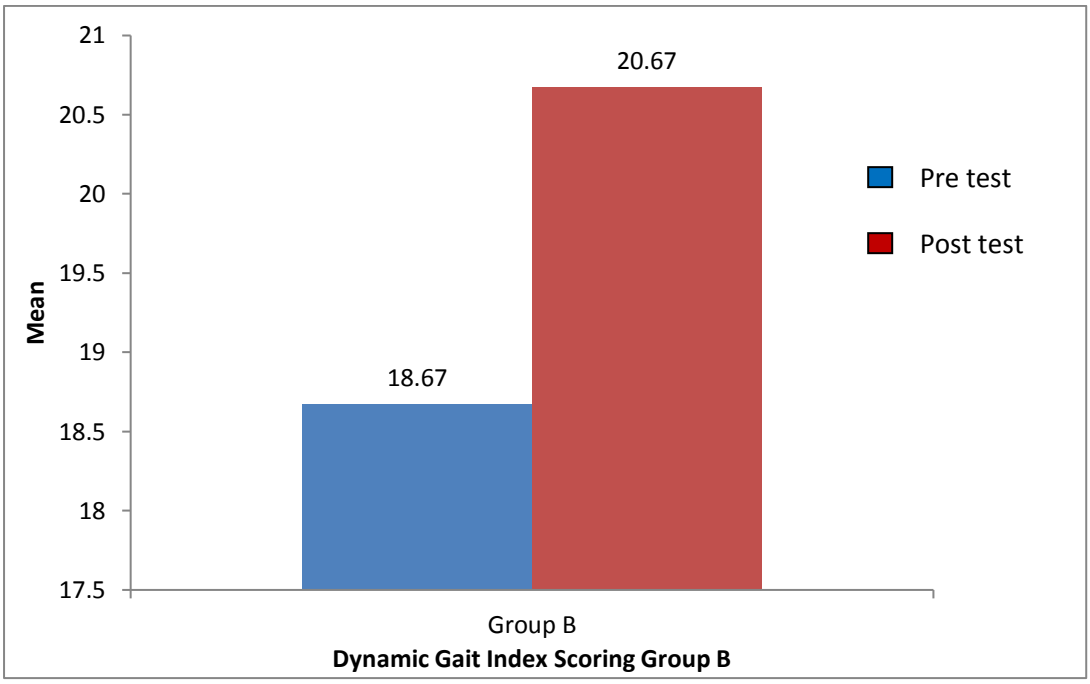
DYNAMIC GAIT INDEX

GROUP B

TABLE – 4.2.2

S. no	Pre test	Post test (x_2)	$X_2-X_2^1$	$(X_2-X_2^1)^2$
1	20	21	0.33	0.11
2	19	20	-0.67	0.45
3	20	21	0.33	0.11
4	18	20	-0.67	0.45
5	19	20	-0.67	0.45
6	18	22	1.33	1.77
7	18	20	-0.67	0.45
8	19	23	2.33	5.43
9	18	20	-0.67	0.45
10	19	21	0.33	0.11
11	18	20	-0.67	0.45
12	18	21	0.33	0.11
13	19	20	-0.67	0.45
14	18	21	0.33	0.11
15	19	20	-0.67	0.45

Graph IV Dynamic gait index scoring for Group B



Dynamic Gait Index Scoring for Group

Outcome measure	Test	Mean	Standard deviation (SD)	Calculated 't' value	P value
DGIS	**Pretest**	18.67	0.72	7.2457	<0.0001
	Posttest	20.67	0.90		

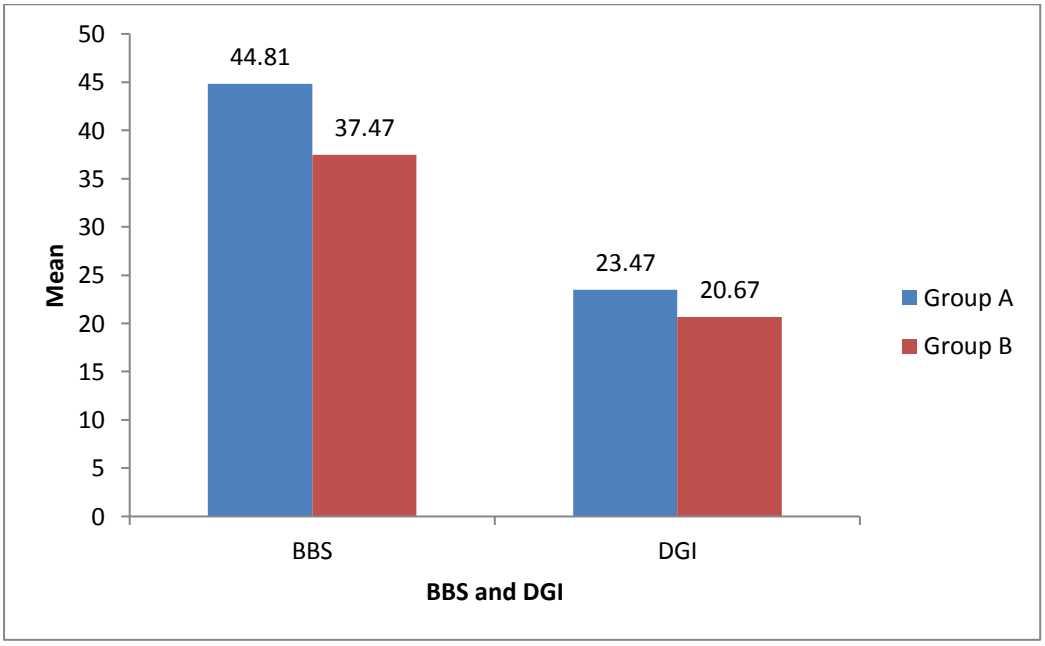
There was a significant difference in the Dynamic gait index scale of Group B at the level 0.05% at 14 degrees of freedom.

Table V: Comparison of Berg balance scale and Dynamic Gait Index in both the groups

Outcome measure	Groups	Mean	Standard deviation (SD)	Calculated 't' value	P value
Berg Balance scale	Group A	44.81	3.76	6.495	<0.0001
	Group B	37.47	2.24		
Dynamic gait index	Group A	23.47	0.52	10.433	<0.0001
	Group B	20.67	0.90		

There was a significant difference in the in Experimental group and control group at the level 0.05% at 28 degrees of freedom.

Graph V: Comparison of Berg Balance Scale and Dynamic Gait Index in both the groups



Discussion

5. DISCUSSION

Dynamic gait index (DGI) & Berg balance scale (BBS) were used to assess patients balance and gait significant difference between pre and post scores on statistical analysis were observed. After 4 weeks the post test scores shows a change in DGI readings but BBS scores shows only mild difference in experimental group which indicates that improvement in balance remain constant even after the post treatment. However no significant difference between BBS post test and follow up readings were observed. Proprioception is a factor often compromised in diabetic neuropathy which may lead to reduced balance, increased risk of falling & subsequent fear of falling, so it is important to focus on improving balance which can reduce incidence of falls & sustained injuries. This study focused on balance and gait in DPN patients which can be improved by balance training on stability trainer & helps to reduce the fall risk. A study done by *Ajimsha, et al (2011)* supported the results of the present study who also found that stability trainer is effective for improving static balance with distal sensory diabetic neuropathy. A study done by *Shah &Jayavant (2006)* on ambulatory hemiplegic patients found that training on stability trainer in different posture, at appropriate challenge levels, helps to improve balance in these patients Somatosensory training using stability trainer can also augment increased proprioceptive firing from the cutaneous receptors from the feet & also from mechanoreceptors of the muscles during co-contraction produced by the swaying movements, while standing on stability trainer. The greater improvement in the experimental group as compared to the control group might be due to the fact that, practicing balance training in progressive challenging levels is indicative of its potential to enhance somatosensory integration with visual & vestibular senses in CNS. Stability trainer provides an unsteady surface that challenges the body to maintain balance. During the exercise intervention with stability trainer, sensory inputs could be manipulated by altering the support surfaces and environments.

Conclusion

6. CONCLUSSION

Our study shows that stability training is effective in improving gait and balance in type2 diabetes mellitus patient and can be added as part of rehabilitation programe.

6.1 RECOMMENDATIONS FOR THE STUDY

- For further studies we can include type1 diabetes mellitus patient also.
- More study duration is required for better balance.
- More patient referral is required.

6.2 LIMITATIONS OF THE STUDY

- Small sample size.
- Study duration was short.
- Convincing the patient to participate in rehabilitation was difficult.

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Appendices

APPENDICES

APPENDIX I

BERG BALANCE TESTS AND RATING SCALE

Patient Name

_____

Date _____

Location _____

Rater _____

ITEM DESCRIPTION SCORE (0-4) Sitting to standing _____ Standing unsupported _____ Sitting

unsupported _____ Standing to sitting _____ Transfers _____ Standing with eyes closed _____

Standing with feet together _____ Reaching forward with outstretched arm _____ Retrieving object

from floor _____ Turning to look behind _____ Turning 360 degrees _____ Placing alternate foot

on stool _____ Standing with one foot in front _____ Standing on one foot _____

TOTAL _____

GENERAL INSTRUCTIONS

Please demonstrate each task and/or give instructions as written. When scoring, please record the lowest response category that applies for each item. In most items, the subject is asked to maintain a given position for a specific time. Progressively more points are deducted if the time or distance requirements are not met, if the subject's performance warrants supervision, or if the subject touches an external support or receives assistance from the examiner. Subjects should

understand that they must maintain their balance while attempting the tasks. The choices of which leg to stand on or how far to reach are left to the subject. Poor judgment will adversely influence the performance and the scoring. Equipment required for testing are a stopwatch or watch with a second hand, and a ruler or other indicator of 2, 5 and 10 inches (5, 12 and 25 cm). Chairs used during testing should be of reasonable height. Either a step or a stool (of average step height) may be used for item #12.

1. SITTING TO STANDING

INSTRUCTIONS: Please stand up. Try not to use your hands for support.

( ) 4 able to stand without using hands and stabilize independently

( ) 3 able to stand independently using hands

( ) 2 able to stand using hands after several tries

( ) 1 needs minimal aid to stand or to stabilize

( ) 0 needs moderate or maximal assist to stand

2. STANDING UNSUPPORTED

INSTRUCTIONS: Please stand for two minutes without holding.

( ) 4 able to stand safely 2 minutes

( ) 3 able to stand 2 minutes with supervision

( ) 2 able to stand 30 seconds unsupported

( ) 1 needs several tries to stand 30 seconds unsupported

( ) 0 unable to stand 30 seconds unassisted

If a subject is able to stand 2 minutes unsupported, score full points for sitting unsupported.

Proceed to item #4.

3. SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED ON FLOOR OR ON ASTOOL

INSTRUCTIONS: Please sit with arms folded for 2 minutes.

( ) 4 able to sit safely and securely 2 minutes

( ) 3 able to sit 2 minutes under supervision

( ) 2 able to sit 30 seconds

( ) 1 able to sit 10 seconds

( ) 0 unable to sit without support 10 seconds

4. STANDING TO SITTING

INSTRUCTIONS: Please sit down.

( ) 4 sits safely with minimal use of hands

( ) 3 controls descent by using hands

( ) 2 uses back of legs against chair to control descent

( ) 1 sits independently but has uncontrolled descent

( ) 0 needs assistance to sit

5. TRANSFERS

INSTRUCTIONS: Arrange chairs(s) for a pivot transfer. Ask subject to transfer one way toward a seat with armrests and one way toward a seat without armrests. You may use two chairs (one with and one without armrests) or a bed and a chair.

( ) 4 able to transfer safely with minor use of hands

( ) 3 able to transfer safely definite need of hands

( ) 2 able to transfer with verbal cueing and/or supervision

( ) 1 needs one person to assist

( ) 0 needs two people to assist or supervise to be safe

6. STANDING UNSUPPORTED WITH EYES CLOSED

INSTRUCTIONS: Please close your eyes and stand still for 10 seconds.

( ) 4 able to stand 10 seconds safely

( ) 3 able to stand 10 seconds with supervision

( ) 2 able to stand 3 seconds

( ) 1 unable to keep eyes closed 3 seconds but stays steady

( ) 0 needs help to keep from falling

7. STANDING UNSUPPORTED WITH FEET TOGETHER

INSTRUCTIONS: Place your feet together and stand without holding.

( ) 4 able to place feet together independently and stand 1 minute safely

( ) 3 able to place feet together independently and stand for 1 minute with supervision

( ) 2 able to place feet together independently but unable to hold for 30 seconds

( ) 1 needs help to attain position but able to stand 15 seconds with feet together

( ) 0 needs help to attain position and unable to hold for 15 seconds

8. REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING

INSTRUCTIONS: Lift arm to 90 degrees. Stretch out your fingers and reach forward as far as you can. (Examiner places a ruler at end of fingertips when arm is at 90 degrees. Fingers should not touch the ruler while reaching forward. The recorded measure is the distance forward that the finger reaches while the subject is in the most forward lean position. When possible, ask subject to use both arms when reaching to avoid rotation of the trunk.)

( ) 4 can reach forward confidently >25 cm (10 inches)

( ) 3 can reach forward >12 cm safely (5 inches)

( ) 2 can reach forward >5 cm safely (2 inches)

( ) 1 reaches forward but needs supervision

( ) 0 loses balance while trying/requires external support

9. PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION

INSTRUCTIONS: Pick up the shoe/slipper which is placed in front of your feet.

( ) 4 able to pick up slipper safely and easily

( ) 3 able to pick up slipper but needs supervision

( ) 2 unable to pick up but reaches 2-5cm (1-2 inches) from slipper and keeps balance independently

( ) 1 unable to pick up and needs supervision while trying

( ) 0 unable to try/needs assist to keep from losing balance or falling

10. TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING

INSTRUCTIONS: Turn to look directly behind you over toward left shoulder. Repeat to the right. Examiner may pick an object to look at directly behind the subject to encourage a better twist turn.

( ) 4 looks behind from both sides and weight shifts well

( ) 3 looks behind one side only other side shows less weight shift

( ) 2 turns sideways only but maintains balance

( ) 1 needs supervision when turning

( ) 0 needs assist to keep from losing balance or falling

11. TURN 360 DEGREES

INSTRUCTIONS: Turn completely around in a full circle. Pause. Then turn a full circle in the other direction.

( ) 4 able to turn 360 degrees safely in 4 seconds or less

( ) 3 able to turn 360 degrees safely one side only in 4 seconds or less

( ) 2 able to turn 360 degrees safely but slowly

( ) 1 needs close supervision or verbal cueing

( ) 0 needs assistance while turning

12. PLACING ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED

INSTRUCTIONS: Place each foot alternately on the step/stool. Continue until each foot has touched the step/stool four times.

( ) 4 able to stand independently and safely and complete 8 steps in 20 seconds

( ) 3 able to stand independently and complete 8 steps in >20 seconds

( ) 2 able to complete 4 steps without aid with supervision

( ) 1 able to complete >2 steps needs minimal assist

( ) 0 needs assistance to keep from falling/unable to try

13. STANDING UNSUPPORTED ONE FOOT IN FRONT

INSTRUCTIONS: (DEMONSTRATE TO SUBJECT) Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject's normal stride width)

( ) 4 able to place foot tandem independently and hold 30 seconds

( ) 3 able to place foot ahead of other independently and hold 30 seconds

( ) 2 able to take small step independently and hold 30 seconds

( ) 1 needs help to step but can hold 15 seconds

( ) 0 loses balance while stepping or standing

14. STANDING ON ONE LEG

INSTRUCTIONS: Stand on one leg as long as you can without holding.

( ) 4 able to lift leg independently and hold >10 seconds

( ) 3 able to lift leg independently and hold 5-10 seconds

( ) 2 able to lift leg independently and hold = or >3 seconds

( ) 1 tries to lift leg unable to hold 3 seconds but remains standing independently

( ) 0 unable to try or needs assist to prevent fall

TOTAL SCORE (Maximum = 56: _____

APPENDIX II

DYNAMIC GAIT INDEX

1. Gait level surface _____

Instructions: Walk at your normal speed from here to the next mark (20')

Grading: Mark the lowest category that applies.

(3) Normal: Walks 20', no assistive devices, good sped, no evidence for imbalance, normal gait pattern

(2) Mild Impairment: Walks 20', uses assistive devices, slower speed, mild gait deviations.

(1) Moderate Impairment: Walks 20', slow speed, abnormal gait pattern, evidence for imbalance.

(0) Severe Impairment: Cannot walk 20' without assistance, severe gait deviations or imbalance.

2. Change in gait speed _____

Instructions: Begin walking at your normal pace (for 5'), when I tell you "go," walk as fast as you can (for5') When I tell you "slow," walk as slowly as you can (for 5').

Grading: Mark the lowest category that applies.

(3) Normal: Able to smoothly change walking speed without loss of balance or gait deviation. Shows a significant difference in walking speeds between normal, fast and slow speeds.

(2) Mild Impairment: Is able to change speed but demonstrates mild gait deviations, or not gait deviations but unable to achieve a significant change in velocity, or uses an assistive device.

(1) Moderate Impairment: Makes only minor adjustments to walking speed, or accomplishes a change in speed with significant gait deviations, or changes speed but has significant gait deviations, or changes speed but loses balance but is able to recover and continue walking.

(0) Severe Impairment: Cannot change speeds, or loses balance and has to reach for wall or be caught.

3. Gait with horizontal head turns _____

Instructions: Begin walking at your normal pace. When I tell you to "look right," keep walking straight, but turn your head to the right. Keep looking to the right until I tell you, "look left," then keep walking straight and turn your head to the left. Keep your head to the left until I tell you "look straight," then keep walking straight, but return your head to the center.

Grading: Mark the lowest category that applies.

(3) Normal: Performs head turns smoothly with no change in gait.

(2) Mild Impairment: Performs head turns smoothly with slight change in gait velocity, i.e., minor disruption to smooth gait path or uses walking aid.

(1) Moderate Impairment: Performs head turns with moderate change in gait velocity, slows down, staggers but recovers, can continue to walk.

(0) Severe Impairment: Performs task with severe disruption of gait, i.e., staggers outside 15" path, loses balance, stops, reaches for wall.

4. Gait with vertical head turns _____

Instructions: Begin walking at your normal pace. When I tell you to "look up," keep walking straight, but tip your head up. Keep looking up until I tell you, "look down," then keep walking straight and tip your head down. Keep your head down until I tell you "look straight," then keep walking straight, but return your head to the center.

Grading: Mark the lowest category that applies.

(3) Normal: Performs head turns smoothly with no change in gait.

(2) Mild Impairment: Performs head turns smoothly with slight change in gait velocity, i.e., minor disruption to smooth gait path or uses walking aid.

(1) Moderate Impairment: Performs head turns with moderate change in gait velocity, slows down, staggers but recovers, can continue to walk.

(0) Severe Impairment: Performs task with severe disruption of gait, i.e., staggers outside 15" path, loses balance, stops, reaches for wall.

5. Gait and pivot turn _____

Instructions: Begin walking at your normal pace. When I tell you, "turn and stop," turn as quickly as you canto face the opposite direction and stop.

Grading: Mark the lowest category that applies.

(3) Normal: Pivot turns safely within 3 seconds and stops quickly with no loss of balance.

(2) Mild Impairment: Pivot turns safely in > 3 seconds and stops with no loss of balance.

(1) Moderate Impairment: Turns slowly, requires verbal cueing, requires several small steps to catch balance following turn and stop.

(0) Severe Impairment: Cannot turn safely, requires assistance to turn and stop.

6. Step over obstacle ____

Instructions: Begin walking at your normal speed. When you come to the shoebox, step over it, not around it, and keep walking.

Grading: Mark the lowest category that applies.

(3) Normal: Is able to step over the box without changing gait speed, no evidence of imbalance.

(2) Mild Impairment: Is able to step over box, but must slow down and adjust steps to clear box safely.

(1) Moderate Impairment: Is able to step over box but must stop, then step over. May require verbal cueing.

(0) Severe Impairment: Cannot perform without assistance.

7. Step around obstacles _____

Instructions: Begin walking at normal speed. When you come to the first cone (about 6' away), walk around the right side of it. When you come to the second cone (6' past first cone), walk around it to the left.

Grading: Mark the lowest category that applies.

(3) Normal: Is able to walk around cones safely without changing gait speed; no evidence of imbalance.

(2) Mild Impairment: Is able to step around both cones, but must slow down and adjust steps to clear cones.

(1) Moderate Impairment: Is able to clear cones but must significantly slow, speed to accomplish task, or requires verbal cueing.

(0) Severe Impairment: Unable to clear cones, walks into one or both cones, or requires physical assistance.

8. Steps _____

Instructions: Walk up these stairs as you would at home, i.e., using the railing if necessary. At the top, turnaround and walk down.

Grading: Mark the lowest category that applies.

(3) Normal: Alternating feet, no rail.

(2) Mild Impairment: Alternating feet, must use rail.

(1) Moderate Impairment: Two feet to a stair, must use rail.

(0) Severe Impairment: Cannot do safely.

APPENDIX III

INFORMED CONSENT FORM

I _____ agree to take part in the project study , conducted by _____ , Post graduate student (MPT), Sri Ramakrishna Institute of Paramedical Sciences, College of Physiotherapy, DR. M.G.R Medical University.

I acknowledge that the research study on "" has been explained to me and I understand that agreeing to participate in the research means that I am willing to,

- Provide information about my health status to the researcher.
- Allow the researcher to have access to my medical records, pertaining to the purpose of the study
- Participate in the analysis and treatment program.
- Make myself available for further analysis if required.

I have been informed about the purpose, procedures and measurements involved in the research and my queries towards the research have been clarified.

I understand that my participation is voluntary and can withdraw at any stage of the research.

Contact address: **Signature of the patient /care giver:**

Date: **Signature of the investigator:**